

I – Problem Statement Title (GS 129)

Development of Maintenance Inspection Practices for Earth Retaining Systems

II – Research Problem Description

Question: What maintenance inspection practices should the California Department of Transportation (Department) institute for the proper management for our inventory of earth retaining systems?

Develop maintenance inspection practices for earth retaining systems (ERS) that the Department could implement to ensure that the most proactive and preventative measures are being used for one of the fastest growing items in our infrastructural inventory. The Department is constructing an increasing number of ERS consisting of mechanically stabilized embankment (MSE), tieback, soil nail, semi-gravity and hybrid walls to counter the increase in right-of-way costs, to minimize the environmental impacts and to accelerate the project delivery process. These structures are currently being built and placed into service without any plan for regular monitoring, inspection or maintenance by the Department. The risk to the Department is in the undocumented performance and premature degradation of these structures. Inspection practices are needed to monitor the performance of structures located along critical lifelines, to determine when structures are reaching the end of their life cycle and to evaluate structures that have been subjected to seismic or other catastrophic events.

III – Objective

STAP Roadmap Outcome 1: Improved Tools, Techniques and Methods to Monitor and Assess the Performance and Condition of Existing Transportation Structures

The objective of this research is to develop a set of best practices that would be the basis for the creation of a Departmental maintenance inspection program for ERS. The state-of-the-practice for the maintenance inspection of ERS would need to be established through a synthesis of national and international DOT policies and programs. This would include investigation techniques and/or test procedures for each type of ERS. In addition, an investigation of the history of failures for ERS would need to be conducted to prioritize both the type of structures and the elements of the structures requiring monitoring. Furthermore, an examination of a sample of the Department's current inventory of ERS would need to be used to ensure that the best practice recommendations will provide appropriate monitoring and assessment of the overall inventory of ERS. This examination shall include but not be limited to a representative

number of ERS constructed 20 to 30 years ago and shall encompass exhuming coupons, where present, or using NDT methods to assess internal conditions of the structures. The results of this sampling should verify the design parameters that were in place at the time of construction. Lastly, a set of risk assessment parameters based upon the ERS type, vintage of the structure, design criteria and site conditions shall be provided to develop the inspection priorities and frequencies needed to monitor the performance of ERS.

IV – Background

In the last 20 to 30 years the Department has become increasingly reliant upon ERS to minimize right-of-way, environmental and project delivery impacts. The Department has an estimated 3,000 earth retaining systems in the current inventory and approximately 200 new structures are being added per year. The actual numbers are not available, as an inventory of existing ERS does not exist nor is there a statewide tracking system for new ERS that are being added to the State Highway System. The Department has not instituted a maintenance inspection program to establish a baseline assessment for ERS to provide either a reliable indication of performance or substantiation of the existing design methodology. Therefore, it is unknown which ERS are at risk for premature failure and those that are on target for reaching their design life goals.

V – Statement of Urgency, Benefits, and Expected Return on Investment

The Department is not currently monitoring the performance of the large and rapidly growing inventory of ERS. Thus, the Department is placed into a position of only being able to react to failures and crisis as they occur. The Department, regardless of the magnitude and extent of the program, can only benefit by having a systematic inspection and management program for the ERS inventory. The potential return on investment is not likely to be known in the short term, as the number of walls that will experience premature degradation cannot be predicted. However, by using a best practices inspection program to identify structures that are prematurely deteriorating under normal conditions or due to an extreme event or beginning to reach the end of their life cycle, the Department will be able to properly program repair, rehabilitation or replacement projects.

VI – Related Research

The Department has conducted an internal research effort focused on a small sampling of MSE walls that has shown a need for further development of an inspection program. In addition, NCHRP Project 24-28 “LRFD Metal Loss and Service-Life Strength Reduction Factors for Metal-Reinforced Systems in Geotechnical Applications” will be examining testing methods and develop metal loss estimates that will be consistent

with LRFD Bridge Design Specifications. However, there is no known research that encompasses all types of ERS used by the Department.

VII – Deployment Potential

This research will be instrumental in the development of the Department's maintenance inspection program for earth retaining systems.